MONROE TABLE OF MULTIPLYING FACTORS FOR SQUARE ROOTS

The Monroe Table of Multiplying Factors for securing roots gives accuracy to five significant figures. However, in some cases there may be an error of one in the fifth significant figure due to adjusting the final figures in calculating the factors.

INSTRUCTIONS

Odd and Even Factors

For roots of whole numbers and mixed numbers

When the number of whole number digits is ODD, use the factor in ODD (black figures) column.

When the number of whole number digits is EVEN, use the factor in EVEN (blue figures) column.

For roots of decimal numbers

When the number of zeros preceding the first significant figure is ODD, use the factor in ODD column.

When the number of zeros preceding the first significant figure is EVEN, use the factor in EVEN column.

When no zeros precede the first significant figure, use the factor in EVEN column.

Monroe Method

This method can be used on any model of the Monroe Adding-Calculator.

Set the number, the root of which is to be found, on the keyboard of the Monroe and with the carriage in the seventh position register it in the lower dials. Clear keyboard.

In the NUMBER column find the number nearest to the first three left-hand significant figures of the number the root of which is being found. Set this value on the keyboard and add it to the number already in the lower dials of the machine, being sure the left-hand figures are in alignment. Copy the result in the lower dials to the keyboard. Clear upper dials.

By inspection determine, according to the explanation above, whether the factor in the ODD or EVEN column should be used. Select the factor corresponding to the NUMBER value and multiply the amount on the keyboard by this factor. The result in the lower dials of the Monroe is the root of the number to five significant places.

Pointing Off Decimals in Roots

Roots of whole numbers and numbers with decimals

Starting at the decimal point in the number the root of which has been found and working to the left, set off the number into groups of two figures each. The number of such two-figure groups will be the number of whole numbers in the root. If the extreme left-hand group consists of only one figure it should be counted as though a complete group.

Roots of decimal numbers

Starting at the decimal point in the number the root of which has been found and working to the right, set off the zeros preceding the first significant figure into groups of two zeros each. The number of such groups will be the number of zeros that should precede the first significant figure in the root. If the last right-hand group consists of only one zero it should NOT be counted as a group. If no zero, or only one, precedes the first significant figure in the decimal number, then no zeros should precede the first significant figure of its root and the decimal point is placed before the first figure.

Example I

$\sqrt{6942.3214} = ?$

With the machine clear, shift the carriage of the Monroe to the seventh position. Set 69423214 on the right-hand side of the keyboard and register in the lower dials by depressing the plus bar once. Clear keyboard.

Referring to the NUMBER column, 693 is the number nearest to the first left-hand three significant figures of the number whose root is to be found. Set the 693 on the keyboard in line with the 694 in the lower dials and depress the plus bar once. Copy the 138723214 from the lower dials to the keyboard and subtract once to prove. Clear upper dials only.

The factor in the EVEN (blue) column of the table for 693 is 6006250. Multiply the amount on the keyboard by this factor 6006250. The first five left-hand figures of the result in the lower dials, 83320 or 83.320, is the root. The decimal point in the root is found by setting off the number 6942.3214 into groups of two figures each, 69'42'.3214. Since there are two groups of two figures, according to the rule there should be two whole numbers in the root, thus 83.320.

Example II

$\sqrt{.000003912} = ?$

With the carriage in the seventh position, set 3912 on right of keyboard. Depress plus bar once. Clear keyboard. Referring to the NUMBER column of the table, set 390 on the keyboard in line with the 391 in the lower dials and depress the plus bar once. Copy the 7812 from the lower dials to the keyboard and subtract once to prove. Clear upper dials only.

Multiply by 2531848, factor from the ODD column of the table. The first five left-hand figures of the result in the lower dials, 19778 or .0019778 is the root. The decimal point is found by setting off .000003912 into groups of two zeros each starting at the decimal point and working to the right, .00'00'03'912. As there are two groups of two zeros each preceding the first significant figure, two zeros should precede the first significant figure of the root, thus .0019778.

Example III

$\sqrt{730.6789} = ?$ Root required to nine significant figures
A Monroe model with ten columns on the keyboard is required to secure the root to nine places.

With carriage in seventh position, set 7306789 on right of the keyboard. Depress plus bar once. Clear keyboard. Referring to the NUMBER column of the table, set 729 on the keyboard in line with the 730 in the lower dials and depress plus bar once. Copy 14596789 to the keyboard and subtract to prove. Clear upper dials only.

Multiply by 1851852, factor from ODD column of table. The first five left-hand figures of the result in the lower dials, 27031, or when correctly pointed off, 27.031, is the root to five figures. Up to this point a Monroe with an eight column keyboard can be used. To secure the root to nine significant figures and using a ten column model, proceed from this point as follows.

Clear machine and shift carriage to tenth position. Set 7306789 on the extreme left of the keyboard. Depress plus bar once. Clear upper dials and keyboard.

Set 27031 (root secured above) on the extreme left of the keyboard. Divide. Copy 2703114572 from the upper dials of the keyboard. Clear both upper and lower dials. By depressing the plus bar register 2703114572 in the lower dials Set the root, 27031, on the extreme left of the keyboard and depress plus bar once. Clear keyboard and upper dials. Set 2 on the extreme right of the keyboard. Shift carriage to tenth position and divide. The answer in the upper dials, 2703107286, which when pointed off is 27.0310729, the root.

Following this method an eight column Monroe can be used to find the root to eight places.

MONROE CALCULATING MACHINE COMPANY, INC.
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MONROE TABLE OF
MULTIPLYING FACTORS FOR SQUARE ROOTS

For accuracy of five significant figures in roots. See reverse for explanation and instructions.

NUMBER	MULTIPLYING FACTORS ODD	MULTIPLYING FACTORS EVEN	NUMBER	MULTIPLYING FACTORS ODD	MULTIPLYING FACTORS EVEN	NUMBER	MULTIPLYING FACTORS ODD	MULTIPLYING FACTORS EVEN
101	497 5186	157 3292	236	325 4723	102 9234	510	221 4037	700 1400
103	492 6646	155 7942	240	322 7486	102 0621	517	219 8997	695 3841
105	487 9500	154 3034	244	320 0922	101 2220	524	218 4260	690 7237
107	483 3682	152 8545	248	317 5003	100 4024	531	216 9815	686 1558
109	478 9131	151 4456	252	314 9704	996 0238	538	215 5653	681 6774
111	474 5790	150 0751	256	312 5000	988 2118	545	214 1765	677 2855
113	470 3604	148 7410	260	310 0868	980 5807	552	212 8141	672 9774
115	466 2524	147 4420	264	307 7287	973 1237	559	211 4775	668 7505
117	462 2502	146 1763	268	305 4236	965 8343	566	210 1657	664 6022
119	458 3492	144 9428	272	303 1695	958 7062	573	208 8780	660 5302
121	454 5455	143 7399	276	300 9646	951 7337	580	207 6137	656 5322
123	450 8348	142 5665	280	298 8072	944 9112	588	206 1965	652 0507
125	447 2136	141 4214	284	296 6954	938 2333	596	204 8080	647 6597
127	443 6783	140 3034	288	294 6278	931 6950	604	203 4471	643 3563
129	440 2255	139 2115	292	292 6029	925 2915	612	202 1130	639 1375
131	436 8520	138 1447	296	290 6191	919 0183	620	200 8048	635 0006
133	433 5550	137 1021	300	288 6751	912 8709	628	199 5217	630 9431
135	430 3315	136 0828	304	286 7697	906 8453	636	198 2629	626 9623
137	427 1788	135 0858	308	284 9014	900 9375	644	197 0276	623 0560
139	424 0945	134 1104	312	283 0693	895 1436	652	195 8151	619 2218
141	421 0760	133 1559	316	281 2720	889 4601	660	194 6247	615 4575
143	418 1210	132 2215	320	279 5085	883 8835	668	193 4558	611 7610
145	415 2274	131 3064	325	277 3501	877 0580	676	192 3077	608 1303
147	412 3930	130 4101	330	275 2409	870 3883	684	191 1798	604 5635
149	409 6160	129 5319	335	273 1792	863 8684	693	189 9343	600 6250
151	406 8942	128 6713	340	271 1631	857 4929	702	188 7128	596 7624
153	404 2260	127 8275	345	269 1910	851 2565	711	187 5147	592 9734
155	401 6097	127 0001	350	267 2612	845 1543	720	186 3390	589 2557
157	399 0434	126 1886	355	265 3724	839 1814	729	185 1852	585 6070
159	396 5258	125 3925	360	263 5231	833 3333	738	184 0525	582 0252
161	394 0552	124 6112	365	261 7120	827 6059	747	182 9404	578 5084
164	390 4344	123 4662	370	259 9376	821 9949	756	181 8482	575 0546
167	386 9116	122 3522	375	258 1989	816 4966	765	180 7754	571 6620
170	383 4825	121 2678	380	256 4946	811 1071	774	179 7213	568 3286
173	380 1430	120 2118	385	254 8236	805 8230	783	178 6854	565 0529
176	376 8892	119 1828	390	253 1848	800 6408	792	177 6673	561 8332
179	373 7175	118 1799	395	251 5773	795 5573	802	176 5561	558 3195
182	370 6247	117 2018	400	250 0000	790 5694	812	175 4656	554 8710
185	367 6073	116 2476	406	248 1458	784 7060	822	174 3950	551 4855
188	364 6625	115 3164	412	246 3323	778 9712	832	173 3438	548 1613
191	361 7873	114 4072	418	244 5580	773 3603	842	172 3114	544 8964
194	358 9791	113 5192	424	242 8215	767 8689	852	171 2972	541 6892
197	356 2353	112 6515	430	241 1214	762 4929	862	170 3007	538 5380
200	353 5534	111 8034	436	239 4566	757 2282	872	169 3214	535 4412
203	350 9312	110 9742	442	237 8257	752 0710	882	168 3588	532 3971
206	348 3665	110 1632	448	236 2278	747 0179	892	167 4124	529 4044
209	345 8572	109 3697	454	234 6616	742 0652	902	166 4818	526 4616
212	343 4014	108 5931	460	233 1262	737 2098	913	165 4758	523 2806
215	340 9972	107 8328	466	231 6205	732 4484	924	164 4879	520 1565
218	338 6427	107 0882	472	230 1437	727 7781	935	163 5175	517 0877
221	336 3364	106 3589	478	228 6947	723 1961	946	162 5640	514 0726
224	334 0766	105 6443	484	227 2727	718 6995	957	161 6270	511 1096
227	331 8617	104 9439	490	225 8770	714 2857	968	160 7061	508 1973
230	329 6902	104 2572	496	224 5066	709 9523	979	159 8007	505 3342
233	327 5609	103 5838	503	222 9390	704 9950	990	158 9104	502 5189
						998	158 2722	500 5008